RESEARCH
ENGINEERING THE FUTURE

September 2008

Welcome to the Utah Department of Transportation (UDOT) Research Division Newsletter.

The newsletter is a quarterly publication that provides current information on the Division's research activities.

We will also anchor each newsletter with articles from other sources on issues we consider to be interesting and important. Our goal in Research is to be at the forefront of innovation, and we will be using this newsletter to bring you information on what's new and progressive in transportation.

We are happy to share with you what UDOT is researching and how we are implementing new technologies.

Sincerely,
The UDOT Research Team

In This Issue: (click on desired article, click on logo at top to return to this page)

By: Abdul Wakil
UDOT Research Division

INNOVATION & EFFICIENCY AWARD: UDOT ACCELERATED BRIDGE CONSTRUCTION TEAM

On June 3, 2008 the Utah Department of Transportation (UDOT) Accelerated Bridge Construction (ABC) Team received the Governor's "Excellence in Innovation & Efficiency" Award. This recognition was given for the commitment, dedication, innovation and creativity this team has provided to increase the efficiency of the Department, highlight the ability to produce superior results, help successfully execute ABC projects, and leave a profound impact on the citizens of the State of Utah.

Award recipients were: Mr. Jim McMinimee, Director for Project Development; Ms. Shana Lindsey, Director for Research & Bridge Operations; Mr. Randy Park, Director for Region Two; and Ms. Lisa Wilson,

Left to Right: Mr. John Njord, UDOT Executive Director; Ms. Shana Lindsey, Director for UDOT Research & Bridge Operations; Ms. Lisa Wilson, UDOT Region Two Project Manager; Mr. Randy Park, Director for UDOT Region Two; and Mr. Jim McMinimee, Director for UDOT Project Development.

Governor Jon Huntsman honors the 2008 Award winners, The UDOT ABC Team, on being selected as a recipient of the *2008 Governors Award for Excellence In Innovation and Efficiency*.

Project Manager for Region Two.

With strong leadership support, UDOT has decided to make Accelerated Bridge Construction (ABC) its standard practice and has taken a structured approach in the implementation of this initiative. ABC sometimes involves replacing a bridge with prefabricated elements and systems. In other cases, ABC involving the construction of an entire bridge in a staging area, and then moving it into place. A decision chart was developed to determine when to do ABC, and what approach to take.

Implementing ABC techniques has resulted in great success for UDOT, allowing an existing bridge to stay in service while the majority of the construction takes place off-site. In one instance, 4500 South and I-215 in Salt Lake County, a project which could have resulted in five to six months of road closures and detours, resulted in a shutdown of I- 215 for only one weekend and 4500 South for only 10 days. It proved how innovative techniques can reap real benefits in terms of reducing user impacts, minimizing traffic delays or disruptions and saving Utah travelers precious time. Overall, when user impacts were included in an analysis of the real project cost by the University of Utah Traffic Laboratory, researchers found the innovation saved the community $4 million on the project, slashing what could have been a $12 million price tag by a third.

ABC is the future of bridge construction in Utah and will continue to grow and improve as more ABC standards are developed and refined with lessons learned. UDOT values the public and its industry partners and will continue to work with them to address their needs. ABC is helping UDOT achieve its mission of "Quality Transportation Today and Better Transportation Tomorrow"..... ❑

By: Shana Lindsey
Director for UDOT Research & Bridge Operations

UDOT ACCELERATED BRIDGE CONSTRUCTION WORKSHOP

The Utah Department of Transportation (UDOT) will hold an Accelerated Bridge Construction (ABC) workshop on Wednesday, September 17, 2008 from 8:00 am to 5:00 pm at the E Center, 3100 South Decker Lake Dr., West Valley City, Utah.

UDOT has a goal of making Accelerated Bridge Construction (ABC) a standard practice by 2010. In order to achieve this goal, the Department will develop more standard details for accelerated bridge components. This will include, among other things, new precast bridge girders, precast substructure components, culverts and wildlife crossing structures. The Utah DOT values the input from our industry partners; therefore, this workshop has been scheduled to present the preliminary ABC standards and gather input from all stakeholders.

UDOT would like to invite you for this workshop. For more information about the workshop, please contact Rebecca Nix at rnix@utah.gov.....❑

By: Shana Lindsey
Director for UDOT Research & Bridge Operations

BRIDGE INSTRUMENTATION FOR ACCELERATED BRIDGE CONSTRUCTION AT UDOT

The Utah Department of Transportation (UDOT) is continuing its journey of staying on the leading edge of new technologies.

Over the past few years, UDOT has introduced an aggressive program to implement Accelerated Bridge Construction (ABC) practices. This program uses a variety of methods including prefabricated components, and specialized lift equipment to dramatically reduce construction schedules and impacts.

One of the issues raised from the ABC experience has been a concern over the uncertainty of how construction loads and stresses are impacting the long term durability of the bridge. Under the leadership of Shana Lindsey, P.E. (Director of Research and Bridge Operations), UDOT has now introduced the use of bridge instrumentation technologies in combination with an ABC project on Interstate 80 to explore this issue.

The goal of using bridge instrumentation on accelerated bridge construction was to better understand and quantify what was happening to the bridge during the construction phase. The instrumentation allows data to be collected on construction loading, stresses and deflections. These values can then be compared to acceptable material and design limits. In addition, the data can be compared to "in-service" loading conditions to help determine how construction methods may affect long term durability of the structure. The goals of the instrumentation project include collecting data to address the following questions:

- Are construction stresses exceeding allowable design and material limits?
- Are deflections exceeding allowable limits during construction?
- Can instrumentation be used to supplement visual inspection during lifting and construction?
- Do the special lifting, prefabrication or construction practices affect long term durability of the structure?

To address the goals of the project, the following instruments were installed and data collected:

- Stress and strain gages at key pick points on the deck surface
- Stress and strain gages at key moment and shear locations on steel girders
- Temperature gages on deck and girders
- Displacement gages to measure deflection at key locations
- Log of key events during construction to correlate with instrumentation
- Video log of construction to correlate with instrumentation results.

The first use of the data gathered was to supplement the visual inspection with real time information during the movement of the bridge. The instrumentation can identify subtle deflections and internal stresses that visual inspection can not.

The second use of the data is to evaluate and analyze the data after the construction event. This is done to confirm that allowable stresses were not exceeded. Minimum and maximum stresses, strains and deflections during construction are also compared to expected in-service values to identify potential areas or durability concerns.

Finally, the data is compared with the construction timeframe to determine if factors such as pick points, traveling speed, temperature, and other variables can be improved.

Benefits of Instrumentation

The use of bridge instrumentation during an accelerated bridge construction project will provide many benefits:

- Reduce the risk of damage to the bridge during construction and the lift phase.
- Identify possible construction defects that otherwise can not be seen allowing for repairs before the project is closed.
- Allow for evaluation of construction methods and continuous improvement in standards for prefabrication, lift points, transporting, cure times, and materials.
- Possible reduction of materials used through better comparison of actual stresses to safety factors and designs.
- Extended life and durability of the bridge.

Innovation through Instrumentation

The use of bridge instrumentation on an accelerated bridge construction project was innovative. Bridge instrumentation has been used for some time. However, many instrumentation projects focus on long term measurements and difficulties are

commonly experienced in instrument reliability, changes in personnel, and declining interest over time.

In comparison, the instrumentation on this project was for a very specific purpose over a very limited time. Real time information was used during the construction process. In addition, the UDOT effort is most likely one of the first to combine instrumentation with ABC efforts.

For more information regarding UDOT bridge instrumentation, please contact Shana Lindsey at rlindsey@utah.gov.....❑

By: Michael Fazio
Deputy Director of Research

TRANSPORTATION POOL FUND STUDIES (TPF)

As with every other funding program, even research funding is dwindling. Of course in research we need to find creative ways to fund research.

Pool fund studies are a creative way to get around the lack of funding, by joining forces with other states, to research subjects of common interest. FHWA has developed a program that allows states to solicit the participation of other states. To solicit participation, the sponsoring state prepares an on-line form that describes the project's background, proposed scope, schedule and budget. If another state wants to participate in the study, the state commits funds on-line. When the project reaches the required commitment, the sponsoring state requests the other participant states to obligate the committed funds, and work begins on the project.

Today we are participating in 14 projects and are the sponsoring State for five more projects. The total annual cost of the program is $155,000 (about $11,071 on average for each project). Each of these projects may cost several hundreds of thousands of dollars and will provide very valuable information to the States participating in these projects. Because of the pool fund concept, the participants each contribute only a fraction of the total cost but still reap the full benefits. The table below lists the pool fund projects UDOT is currently involved in.

If you would like to know more about these projects or about which projects are currently being solicited, please visit the FHWA pool fund site at: http://www.pooledfund.org/

If you are interested in participating in one of the studies, whether or not you have the funding required, please let us know. If you have funding from your org you can commit, we would be glad to make the contribution. If you don't have funding, we can consider the project for State Planning and Research (SP&R) funds.

I hope you can take advantage of this program. For more information, please contact Michael Fazio at mfazio@utah.gov. ❑

Title	Title
Western Alliance for Quality Transportation Construction (WAQTC)	Long-Term Maintenance of LRFD
Western Maintenance Partnership	Development of Performance Properties of Ternary Mixes
Dynamic Passive Pressure on Abutments and Pile Caps	Aurora Project
WASHTOX	Transportation Management Center
Pavement Markings	Evaluation of the Safety Edge
AASHTO Drainage Manual	Long-Term Performance (LTPP) Specific Pavement Study (SPS)
Clear Roads	Traffic Data Collection
Transportation Asset Management Research Program	Length Based Classification
Pacific Northwest Snow fighters	In-stiu Scour Testing Device
	Transportation Curriculum Coordination Council Training MGT
	Implementation of the Simple Performance Test (SPT) for Superpave Validation

By: Clifton Farnsworth and Blaine Leonard
UDOT Research Division

STILL WATCHING I-15:
PART 3 - GEOFOAM WALLS

Many people remember that during the early construction efforts on the I-15 Reconstruction Project in Salt Lake County, a large and far-reaching research effort was initiated.

This unprecedented research effort, known as the I-15 National Test Bed for Transportation Research, ultimately involved 31 research projects supported with $4.67 million of special, dedicated funding. A joint effort by UDOT, FHWA, Utah State University, University of Utah, Brigham Young University, and a variety of private consultants and contractors, the I-15 Test Bed has yielded vast amounts of engineering and construction data. While most of these projects are completed, some of these research efforts are still on-going. This article, the third in a series, summarizes the efforts initiated as part of the I-15 Test Bed to evaluate the performance of expanded polystyrene (EPS Geofoam) embankment fill.

One of the chief design and construction challenges faced during the I-15 Reconstruction was the widening of large earth embankments within limited right-of-way over very soft, compressible subsoils. Designers and contractors met this challenge with a variety of innovative techniques and materials, including light-weight fill, expanded polystyrene (EPS Geofoam) fill, one-stage and two-stage MSE walls, lime-cement column soil stabilization, prefabricated vertical (PV) drains (wick drains), and fairly conventional surcharging. UDOT initiated a long-term monitoring program to evaluate many of these innovative techniques, and this monitoring program is still underway. The program involved the placement of a variety of measuring devices, such as survey points, vertical and horizontal inclinometers, pressure sensors, strain gauges and magnet extensometers.

EPS geofoam was predominantly used on the I-15 Reconstruction Project at locations where adjacent utilities could not tolerate significant foundation settlement.

Measurement of geofoam fill behavior and ground deformation is still underway, and will continue through 2011

However, other considerations for the use of geofoam included stability of the foundation soils and the rapid time of construction, including the elimination of the long time periods usually required for primary consolidation settlement of the foundation soils. More than 3.5 million ft3 of geofoam was used during the I-15 Reconstruction Project, and at the time was the largest use of geofoam on any single project within the United States. The 3rd International Geofoam Conference was held in Salt Lake City in December of 2001, with a conference field trip visiting a number of the geofoam embankment sites.

A variety of research efforts were initiated relative to geofoam embankment fill. Dr. Steve Bartlett, at the University of Utah, has been instrumental in providing insight into the performance of geofoam fill. A 10-year monitoring program was initiated while Steve was a project manager with the Research Division, and included establishment of four different instrumentation arrays at geofoam sites. Measurement of geofoam fill behavior and ground deformation is still underway, and will continue through 2011. Another former Research Division project manager, Clifton Farnsworth, continues to be involved in this effort. An installation and project management report from 2004 describes the instrumentation arrays and the approach being used for monitoring the behavior of geofoam as an embankment fill.

Dr. Dawit Negussey and Armin Stuedlein, of Syracuse University, were involved with the instrument installation and data interpretation for the 100 South Geofoam Array. Their report, from 2003, includes the construction and initial post-construction related behavior of the geofoam wall at this particular location. They conclude that most of the measured geofoam compression occurred during construction, as a direct result of the fill and pavement section placed above the geofoam embankment. However, strain within the geofoam mass met the 1% tolerance for construction related deformation. Projected strain limits for post-construction deformation are also on track to be less than the additional 1% of post-construction strain anticipated over a 50 year time period. Despite meeting the strain tolerances, a caution has been given against using fixed connections between the load-distribution slab and the tilt-up panel wall, as the deformation of the geofoam can potentially cause shearing of a fixed connection.

A numerical modeling study was recently performed under the direction of Dr. Steve Bartlett, at the University of Utah. This research was used to evaluate the stress distribution through the geofoam mass, with field performance data used to calibrate the numerical models. A bilinear elastic model was used to produce realistic and reliable estimations of the seating, gap closure, and elastic compression of the geofoam embank-

"We are still watching, learning, and building upon the vast research effort undertaken during the I-15 Reconstruction.

The use of geofoam fill was just one element of the innovative design and construction efforts undertaken and evaluated."

ment. These types of predictions are important for modeling and designing geofoam embankments and their connections to other systems. Another numerical modeling study further evaluating the behavior of EPS geofoam under seismic conditions is currently being completed under the direction of Dr. Bartlett.

Efforts to compare the relative cost, time of construction, and associated construction-related foundation settlement for geofoam, lime cement column stabilized soil, and 2-stage MSE walls with PV drains and surcharge has also been recently performed by Clifton Farnsworth, at the University of Utah. A paper recently published in the ASCE Journal of Geotechnical and Geoenvironmental Engineering concludes that the use of geofoam on the I-15 Reconstruction Project was only about 1.2 times more expensive than the standard two-stage MSE wall with surcharging and PV drains, comparing only the direct construction costs. However, the use of geofoam embankment was approximately three times faster to construct and generally limited foundation settlements to insignificant levels. The advantages and disadvantages of each of these approaches is valuable information as we continue to include geofoam embankment in our design and construction projects. As monitoring of the geofoam instrument arrays continues to take place over the remaining few years, we will gain further insights into the long-term behavior of geofoam embankment fill, the interaction of this type of technology with other adjacent technologies (i.e. MSE walls), and the global performance of the geofoam walls. Subsequent reports will provide these insights.

So, we are still watching, learning, and building upon the vast research effort undertaken during the I-15 Reconstruction. The use of geofoam fill was just one element of the innovative design and construction efforts undertaken and evaluated. We will continue our efforts to better understand this type of embankment fill and how to employ it more efficiently.

For more information regarding this project, please contact Blaine Leonard at bleonard@utah.gov..... ❑

By: Robert Stewart
UDOT Engineering Services Division

DESIGN BUILD CONSTRUCTION AT UDOT

UDOT was given $1 billion in Critical Highway Needs Funds (CHNF) last year. Along with those funds, the majority of projects needed to be built by 2010.

It was readily apparent the traditional UDOT process could not deliver this program in time. Given the success of design-build (DB) on previous projects, Project Managers decided to use it as the contracting method for many of the CHNF projects.

Design-build is not a new process to UDOT. Before this program, there were 17 projects of various sizes delivered using design-build. UDOT has and continues to be a leader in the use of DB. Most Utahans know of the beginnings of design-build at UDOT. It started with the I-15 Reconstruction Project, which was the largest design-build ever tried in transportation. The project was a huge success and many of the principles used for that project carried forward into today's DB projects.

The Department is still analyzing many complex issues related to DB. Among them are owner- vs. contractor-controlled QC/QA, best-value selection (points-based vs. adjectival), performance vs. prescriptive specifications, ABC, and A+B. The Innovative Contracting Engineers (Robert Stewart and Reuel (Rudy) Alder) are working with Project Mangers, Program Managers, Contractors/Consultants, and Senior Leaders to determine the best direction for these issues.

Strides made to date include helping develop an ePM Network for DB, standardizing RFQ/RFP format

and content, working with Consultant Services to formalize the selection process, and working with Central Construction to formalize the advertising process.

There are a variety of projects and a variety of people working on these projects. UDOT is developing a good base of people who are learning about the differences between DB and the traditional process. With this base, DB is benefitting from many different perspectives. UDOT will likely be one of the top five users of DB after the completion of this program.

For more information regarding Design Build Construction at UDOT, please contact Robert Stewart rstewart@utah.gov or Reuel Alder at ralder@utah.gov. ❑

The Current Design Build Program

PROJECTS IN CONSTRUCTION

Region	Project Name	Project Manager
1	I-15; New Ogden Weber Expansion (I-15 NOW)	Brent DeYoung
1	SR-13; over Bear River 1 mile East of Corinne	Charles Mace
2	I-80, Mt. Delle to Lambs Canyon	Mark Parry
2	3300 South over I-215 East	Mark Parry
2	SR-68; Roadway Widening, Bangerter Hwy to Utah Co.	Matt Zundel
2	I-15; 90th to 106th So. & 90th so. off-ramp	Matt Zundel
1	US-89; 1100 South through Perry	Charles Mace
3	SR-77; I-15 to Springville Main Street	Bryan Adams

UPCOMING PROJECTS

Region	Project Name	Project Manager
1	I-15/Fort Lane, Freeway Interchange, Layton City	Darin Fristrup
2	11400 South	Dan Young
2	I-15 Widening, 500 North to I-215	Richard Manser
3	SR-92; Lehi to Highland, Roadway Widening	Bryan Adams
3	East/West Connector	Bryan Adams
3	Vineyard Connector	Bryan Adams

By: Stan Johnson
UDOT Research Division

CULVERT LINING IN FAILED CULVERT

An ongoing study explores the viability of culvert lining to mitigate repair and replacement costs of failed culverts.

With nearly 47,000 culverts in the Utah Highway System, failure of even a small percentage of those culverts can cause considerable problems. Traffic delays, injuries, and even loss of life can result from a collapsed culvert. Even in non-hazardous situations, culvert failure is a drain on funds already stretched thin by other maintenance activities. In a report on culvert management systems, Michael Fazio, Deputy Director of Research, said, "Culvert repairs range from $90 to $125 per foot of culvert. The average length of a culvert is 70 feet. The cost for repairing one culvert would be about $9,000."

In order to help defray repair and replacement costs, remedial solutions have been developed as alternatives to full replacement. One of those solutions is culvert lining. Culvert linings offer a safe, swift, and cost-effective means to help resolve problems with failing culverts. A recent study examined two, separate methods of culvert lining. In Salina, Utah, a culvert was remediated with a cured-in-place liner. At sites in Manti and Marysville, Utah, Snap-Tite™ brand liners were installed and investigated.

Cured-in-place lining employs a roll of special fabric that is inserted into the culvert, and then inflated with hot air until it conforms to the interior of the culvert. The hot air also cures the materials, strengthening it sufficiently to help it retain its shape under operational stresses. These cured-in-place liners add strength to the old culvert. They are also typically smoother than the original culvert, providing improved flow characteristics. Hydraulic engineers have expressed approval of the higher flow rates.

The Snap-Tite ™ liners are segments of high-density polyethylene (HDPE) that fit together, end to end, and are inserted sequentially into the culvert. As with cured-in-place liners, the snap-together liners also add strength to the culvert and improve flow. In contrast to traditional replacement means, the Snap-Tite™ method has been estimated to cost just under $60 per lineal foot, a potential savings of between $2000 and $4,500 per culvert.

As opposed to replacement, culvert lining is a simple, uncomplicated process. Culverts are cleaned and flushed in preparation for lining. The liner in question is then inserted into the existing culvert with the appropriate equipment (often a simple backhoe). In the case of cured-in-place linings, a "head" is prepared, to which the hot air hoses are connected. The "head" is then positioned at the inlet, and the rest of the fabric is inserted.

Snap-Tite™ liners are inserted male-end first. The male end of the next segment is cleaned and lubricated, and fitted with a gasket. It is pulled into place with a

Installation of Snap-Tite™ brand liner

chain come-along to fit the new culvert segment snugly into the previous segment. When the entire culvert is lined, the ends of the culvert are then sealed with concrete and fitted with air tubes for grouting. Voids around the new liner are filled with grout as soon as the concrete bulkheads have sufficiently set. Finally, any special end treatments are applied to the inlet/outlet as required.

At present, a training manual for installing snap-together liners is being prepared through a joint effort between Utah State University and the UDOT Hydraulics division. This training manual is designed to be used by those with no prior training in culvert lining. This illustrates the ease and utility of using culvert lining to repair qualifying culverts and represents further cost savings in the form of reduced training requirements. Additionally, a crew of just four laborers and a single operator can successfully install a snap-together liner.

Culvert liners require minimal or no excavation and little to no traffic control, depending on the site. They also eliminate the need to replace and compact new backfill, or to replace pavement.

Finally, culvert lining typically takes less time than traditional replacement methods, and allows traffic to flow past the work site uninterrupted. As most of the work takes place outside of the path of travel, safety concerns are also mitigated.

Culvert liners represent a real potential for time and cost savings, and will be a valuable tool for any culvert management program employed by the State of Utah. For any further questions on culverts or culvert liner installation please contact your Region Hydraulic Engineer. UDOT Central Hydraulics maintains contact information on their website at this site. (http://udot.utah.gov/main/f?p=100:pg:4777506987717682000:::1:T,V:285,)

For more information, please contact Stan Johnson, stanjohnson@utah.gov..... ❑

The finished project

By: Daniel Hsiao
UDOT Research Division

GFRP FOR BRIDGE DECK

What is GFRP? It stands for Glass Fiber Reinforced Polymer reinforcing bar. It is a non-metallic bar. It is subject to less corrosion to from winter salt and moisture than a metallic bar.

GFRP bar has a tensile strength (e.g. 95 ksi for #5 bar) greater than steel (Grade 60, 60 ksi) bar. The bigger the GFRP bar, the small the tensile strength will be (e.g. 70 ksi for #10 bar). Steel bar is traditionally used for reinforced concrete design across the country and around the world. We are interested to know if GFRP will be available alternative to steel bar.

It is important to know that GFRP's compression and shear strength are not as desirable as grade 60 bars (60 ksi). Therefore, GFRP rebar is not as suitable for shear and compression design.

The tensile modulus of elasticity (E) of GFRP bar is 5.9 x 10^3 ksi, which is much less than the 29 x 10^3 ksi modulus of steel bar. Because of this, GFRP reinforced concrete is "softer" than steel reinforced concrete. When designing reinforced concrete with GFRP bar, the deflection requirements become the controlling factor for the spacing of the girders. This conclusion from our study was not anticipated.

Will GFRP corrode?

GFRP has no steel corrosion problems from salt and moistures. Basically, it is found to be corrosion free in our usual testing. That is why it caught our attention. But, when different tests are applied, it was discovered that GFRP will corrode. In the lab, when GFRP is submerged in 140^0 hot water with a pH of 13, GFRP bar can be dissolved in 30 days.

In spring of 2008, the UDOT Research Division conducted a scanning tour to investigate the possibility of using GFRP as the viable alternative to steel bars. UDOT currently uses steel rebar but has problems with corrosion from salt (chlorine), with or without epoxy coating. Our goal was to investigate if GFRP rebar can reduce the corrosion problems we have experienced.

We arranged a trip to St. Louis, Missouri and visited the MoDOT GFRP project design consultant, Jacobs Engineering. We asked about their experiences and recommendations from using GFRP. We also visited one of the GFRP suppliers, Hughes Brothers, in Nebraska. After two days of interviewing and evaluations during the scanning tour, the team brought home some implementation ideas.

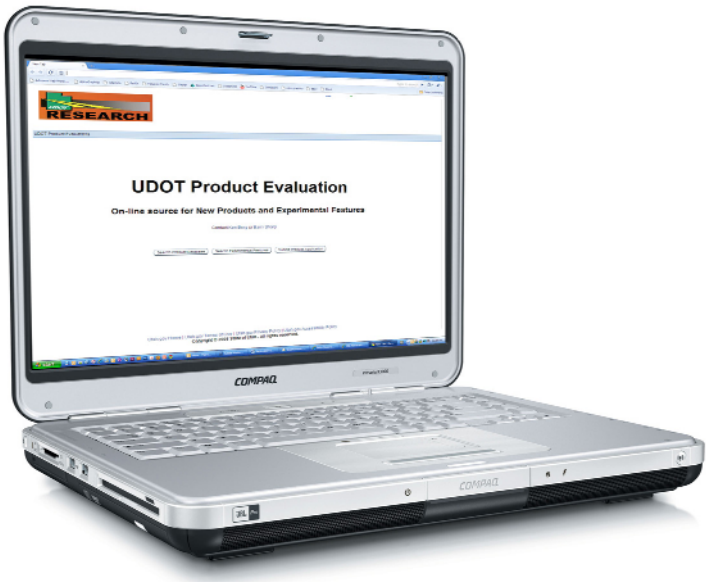
The research team recommended that we will select a few bridge decks to design using GFRP rebar. It was also recommended that for bridges that have a GFRP rebar deck, a visible plaque should be placed on the bridge to inform the future engineers and maintenance crew that GFRP rebar was used in the deck. The plaque will indicate the year the bridge was built, the location of information and specification and the type of rebar which was used. Similar plaques would be placed on decks where other non-standard bars were used, such as MMFX II, stainless clad, low grade stainless steel, etc.

Hopefully the next generation of engineers (maybe 15 years from now), will have a full size lab facility which can simulate a real environment to evaluate the performance of GFRP and other innovative materials. This document will set the tone for the full and real test under the true environment. This experiment will also provide other state DOT officials with guidance in the use of this material. This approach has not been done anywhere else in the nation, nor has it been tried anywhere in the world. The cost is negligible, but the findings could be very convincing and beneficial to the bridge design and maintenance industry.

If there is any question related to this report, please contact Daniel Hsiao at 801-965-4638, or dhsiao@utah.gov.....❑

By: Ken Berg
UDOT Research Division

PRODUCT EVALUATION WEB APPLICATION UPDATE



In 2007 a consultant was hired to take the two MS Access databases that were being used to manage the New Product and Experimental Feature processes and combine them into one web delivered application.

In March of 2008 the Product Evaluation Web application was released for a 30 day beta test with a solicitation for feedback. Many useful comments were received and documented.

Based on the comments received and other functionality and process considerations, the application has been further developed by UDOT's IT division. The application is still in the process of being refined and the data is being updated. The estimated completion date is Sept. 15, 2008.

The current version can be viewed at https://www.udot.utah.gov/public/prod_eval/f?p=158:1:951404465293975::NO:::.

Questions and/or comments about the application are welcome can be directed to Ken Berg kenberg@utah.gov or Barry Sharp rsharp@utah.gov. ❑

UTAH LTAP'S SAFETY SOFTWARE SUITE: Tool for Making Roads & Streets Safer

Approximately three years ago, Mr. Stuart Thompson, former Assistant Director of the Utah LTAP Center, with the able assistance of Mr. Jeff Spaulding, computer programmer, embarked on the development of tools to assist local agencies in assessing crash information for the purposes of making roads and streets safer.

At this time there were many issues in getting complete and accurate data and information on crashes occurring on local roads. The Safety Software Suite endeavor began with the development of a user friendly GIS based crash analysis program using an open architecture GIS program, MapWindow. This was followed with the development of three other highly complimentary tools. These tools are the Traffic Sign Management Module, the Intersection Analysis Module, and the Road Safety Audit Module. All these modules are GIS enabled for easy use with the Crash Analysis Program.

The major features and utility of each of the modules of the Safety Software Suite are described individually as follows:

Crash Analysis Program

This module is based on the crash information that is reported on the D-9 crash report and allows for uploading this information directly to the program with all pertinent data, information, pictures, and diagrams associated with a crash. The program provides four ways to accurately locate a crash on a map. The location tool allows data to be entered by coordinates, mile post, address, or measurement from a known point. This information is housed in an access data base for easy reference via a MapWindow plug-in tool for easy illustration on a map or diagrams. With the location and multiple search tools built in the program all crash information can be easily accessed and a variety of analyses conducted. The Figures 1 and 2 following show some of these major features:

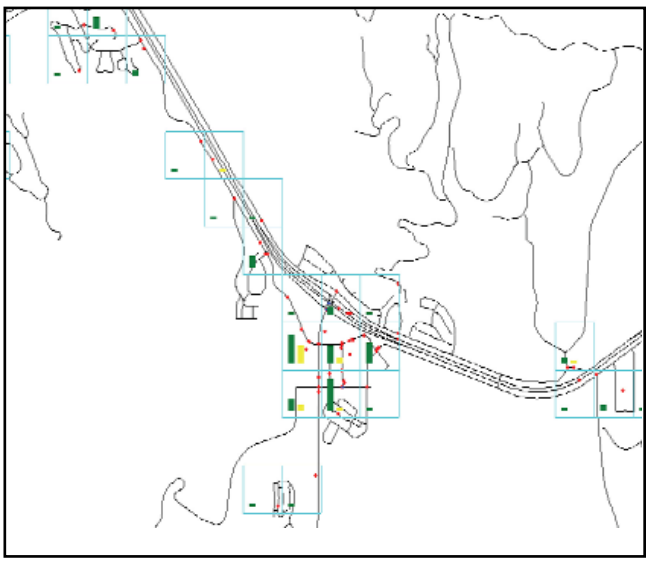


Figure 1 - Map with Crash Features

Figure 2 - Photo with Crash Features

Figure 4 - Intersection Diagram with Features

Traffic Sign Management Module: This module is likewise GIS enabled using a MapWindow plug-in along with the location tool to accurately locate all traffic signs for inventory, condition assessment in accordance with the latest MUTCD visibility requirements, and documentation of actions to be taken. A complete inventory and condition assessment of both the various sign support systems and the signs can be easily made. Provision is also made for all elements of the support system and signs to be documented along with current state of condition. This is illustrated in Figure 3 - Support & Sign Inventory Form. A variety of reports and work orders can be generated within the sign module for management purposes including a sign materials inventory tool to keep track of signs in stock. Included in the module is a complete MUTCD dictionary of signs, a tool to enter pictures, and the six methods for assessing sign retro-reflectivity in accordance with recent MUTCD requirements.

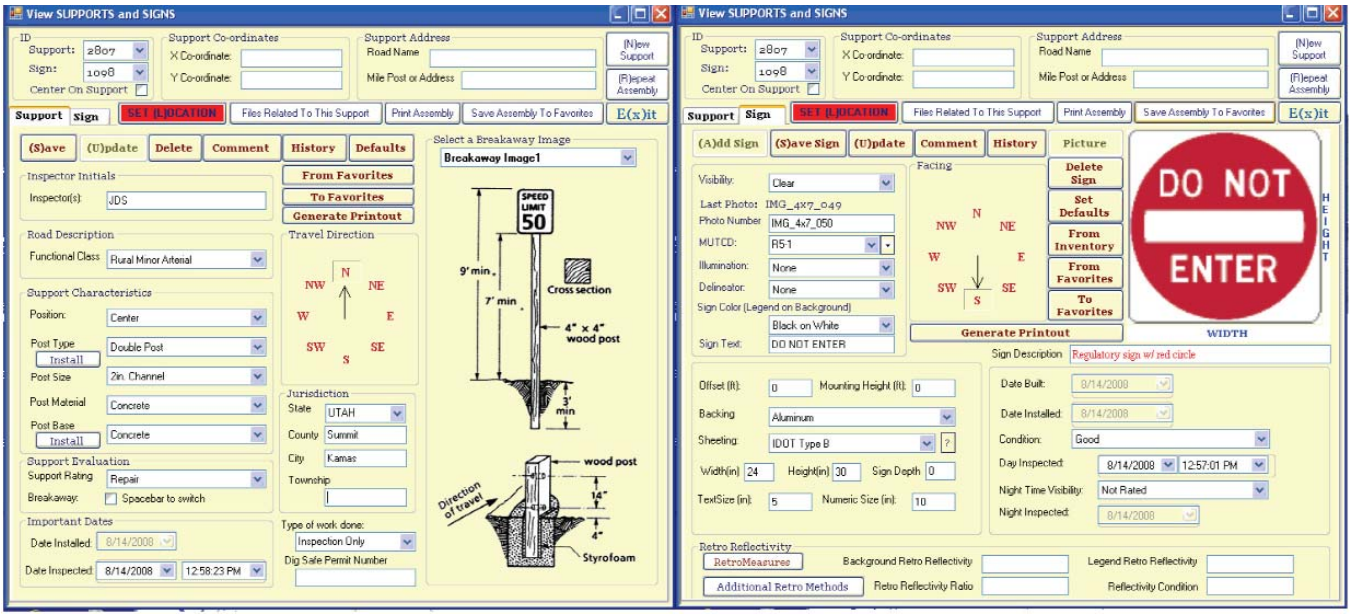


Figure 3 - Support & Sign Inventory Form.

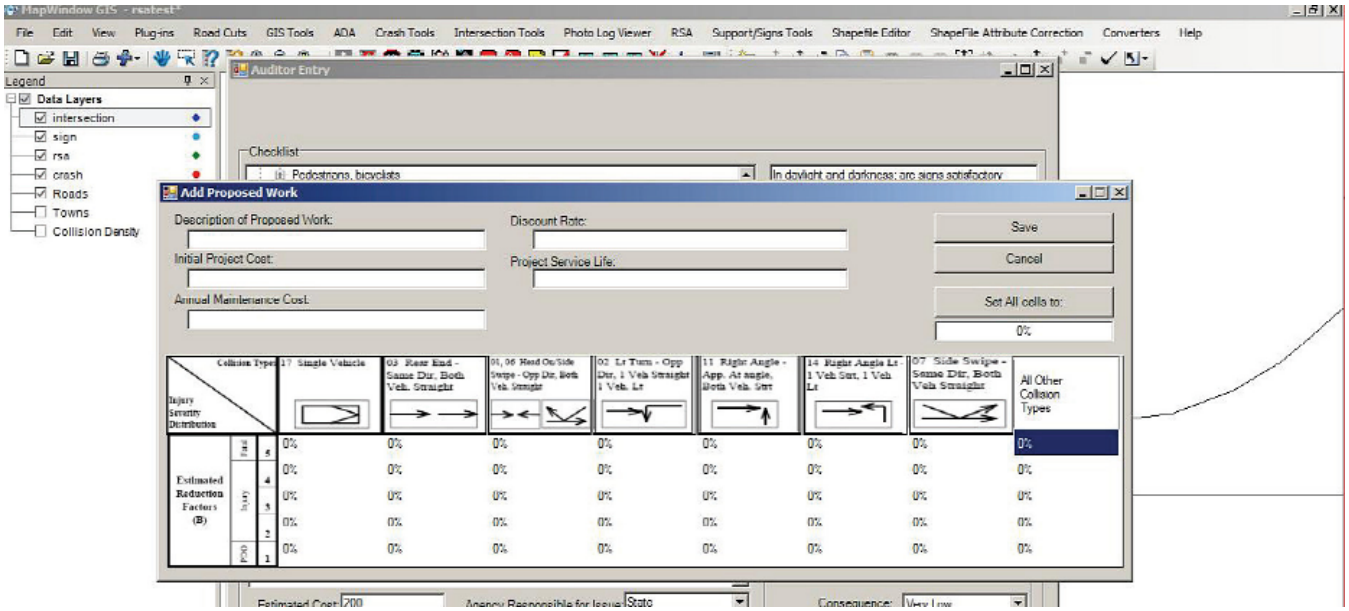


Figure 5 - RSA Crash Analysis Tool

Intersection Analysis Module

The intersection analysis tool addresses all configurations that may exist with respect to intersecting roads and streets. This is done by selecting the appropriate configuration from a library of intersection diagrams contained in the module. These diagrams can be customized to reflect the geometric and traffic conditions that exist along with the potential conflict points and crashes that may have taken place. An example of one of these diagrams is shown in Figure 4 - Intersection Diagram Photo with Features. Crash analyses and potential safety improvements can be easily developed and implemented with the use of the intersection analysis module.

Road Safety Audit Module

The Road Safety Audit Module is based on and modeled after FHWA's Road Safety Audit Guideline and contains all the features including the associated checklists. Included within the RSA module are multiple tools for analyzing all types of crashes. These tools include the mapping and documenting of all features (signs, pavement markings, signals, road geometrics, traffic, & etc.) within the area to assist in evaluating safety counter measures. Based on crash history information and crash rates, severity of injuries and property damage along with existing conditions various counter measures can be evaluated in terms of crash reduction factors and cost benefit analyses. The RSA module is designed to provide a full report of RSA findings, recommendations, and analyses for purposes of follow-up and implementation of safety improvements. Figure 5 - RSA Crash Analysis Tool shows one of the tools.

In summary, the Utah LTAP Center is actively engaged in conducting RSA's of Utah local roads and in assisting local agencies in the implementation of the Safety Software Suite. In so doing credit must be given to Mr. David Beach and staff of the Utah Office of Highway Safety for the financial support for the development and implementation of the Safety Software Suite within Utah Cities and counties. In addition, the UDOT Office of Traffic & Safety and Mr. Roland Stanger, Safety Engineer with the Utah FHWA Division, have been and continue to be very supportive through guidance and technical assistance.

For more information regarding the above tools, please contact the Utah LTAP Center @ utahltap@usu.edu.....❑

By: Dr. Mitsuru Saito
Brigham Young University

EVALUATION OF THE APPLICABILITY OF THE INTERACTIVE HIGHWAY SAFETY DESIGN MODEL TO SAFETY AUDITS OF TWO-LANE RURAL HIGHWAYS

The Interactive Highway Safety Design Model (IHSDM) is a suite of software developed by the Federal Highway Administration (FHWA) for monitoring and analyzing two-lane rural highways in the United States.

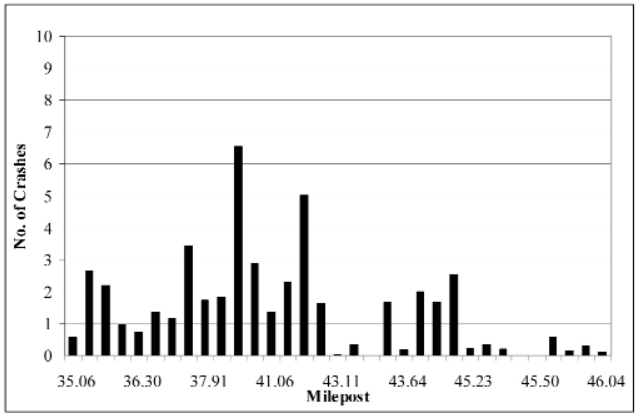
IHSDM is a decision-support tool and currently includes five evaluation modules (Crash Prediction, Design Consistency, Intersection Review, Policy Review, and Traffic Analysis). A sixth module (Driver/Vehicle) is under development. Among the six modules of IHSDM, two were chosen for evaluation because of their applicability to audit safety of the two-lane rural highways in Utah, namely the Crash Prediction Module (CPM) and the Intersection Review Module (IRM).

It was found that the CPM can produce reasonably reliable crash predictions if appropriate input data, especially alignment data, reflect the existing conditions at reasonable accuracy and engineering judgment is used. Using crash records available from the crash database developed by the Utah Department of Transportation (UDOT) and CPM's crash prediction capability, UDOT's traffic and safety engineers can locate "hot spots" for detailed safety audit, thus making the safety audit task more focused and effective. The crash prediction trend by CPM without crash history looks similar to the trend found in the actual crash history; hence, CPM can be used to compare the safety benefits of highway improvement alternatives (alternative alignments) that do not yet have any crash histories. See Figure 1 (following page) for crash prediction trends and Figure 2 for "hot spots" confirmed by actual crash records.

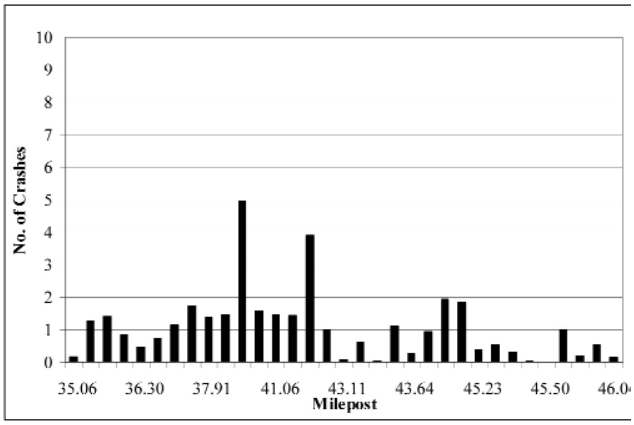
Unlike the CPM, the outputs of the IRM are qualitative and include primarily suggestions and recommendations. They will help the traffic and safety engineers know what to look for as they visit the sites, such as a lack of stopping sight distance and a lack of passing sight distance. Based on the findings of the study, it is concluded that the CPM and IRM of IHSDM could be a useful tool for engineering decision-making during safety audits of two-lane rural highways. However, the outputs from these modules demand knowledge and experience in highway design.

The website of IHSDM is http://www.tfhrc.gov/safety/ihsdm/ihsdm.htm. The 2007 public release of IHSDM is now available for free download. For more information, please contact Dr. Mitsuru Saito at msaito@byu.edu. ❑

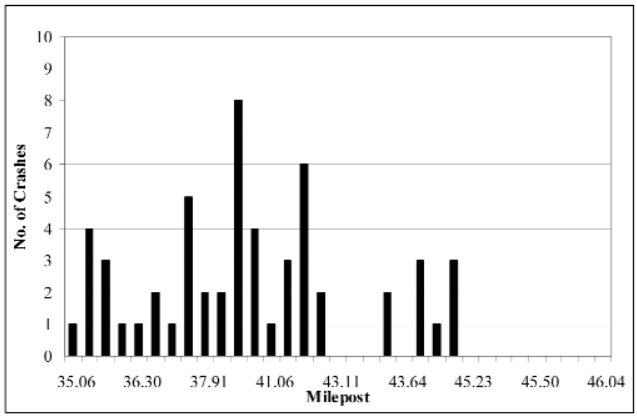
(see charts on following page)



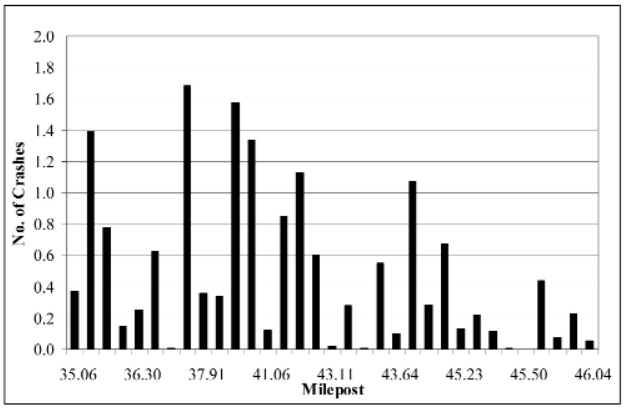
(a) CPM prediction result with crash history



(b) CPM prediction result without crash history



(c) Actual crash history



(d) Difference between CPM prediction results with and without crash history

FIGURE 1 (above) Comparison of CPM outputs for the US-40 study section (number of crashes).

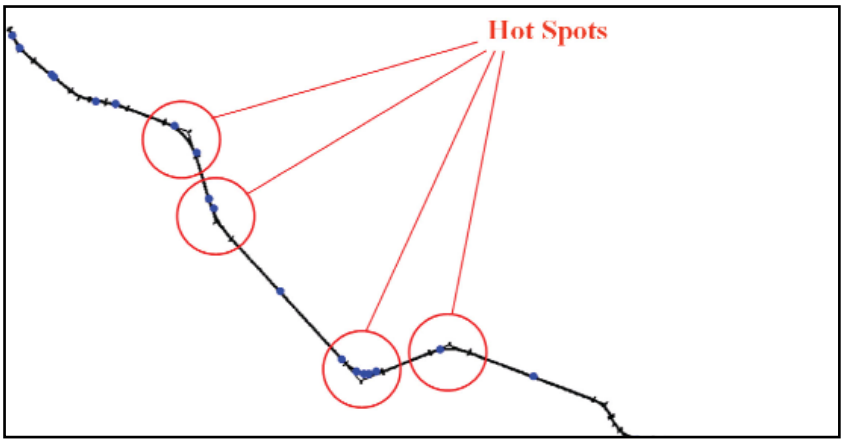


FIGURE 2 "Hot spots" of the US-40 study section.

In The Know:
A Look At Who We Are

After more than thirty-seven years of tennis match with UDOT, Mr. Doug Anderson is retiring.

Doug grew up in the beautiful state of Utah and holds both a Bachelor's and Master's degree from the University of Utah in Civil Engineering.

Mr. Anderson has spent most of his 37-year career at UDOT in the Research Division. He has served in the past as the Division Head in both Research and Planning. He has managed many research projects related to Materials, Pavements, Safety, Web Data Delivery and Policy Research. He officially retired in 2002, but couldn't stay away so he came back to Research for another six years, lending his wisdom, insight, and institutional knowledge to the Department.

Doug believes in research, and has always been a proponent of a balance between cutting edge, sometimes risky, research endeavors, and more practical, applied research. In the 1990's, he was a major force in the development of the I-15 National Test Bed program, where 31 innovative research projects were undertaken within the I-15 reconstruction project. These projects involved all three research universities in Utah, and involved significant risk. Doug's leadership helped insure the success of this program. He has also led projects which advance our understanding of asphalt pavements, pavement noise, pavement maintenance, and pavement durability.

Doug has always believed in the implementation of research results. A great example is the very successful crash database, which many people in the department use to evaluate traffic safety issues. Over a period of many years, Doug has helped create, develop and promote this valuable tool, providing training and encouragement to numerous users. He was also instrumental in the implementation of GPS and GIS in the Department, at a time when many states had not yet seen the value of these tools.

Doug Anderson “The Tennis Man”.

"Doug has been a significant driving force in technology transfer. One such program was a video conferencing program known as the Info-X program, which eventually transformed into the well-known WASHTO-X program"

Doug has been a significant driving force in technology transfer. One such program was a video conferencing program known as the Info-X program, which eventually transformed into the well-known WASHTO-X program. In a day when video conferencing was unproven, Doug had the vision to implement this program to facilitate sharing of ideas and practices among many state DOTs. Doug has also been instrumental in overseeing the Local Technical Assistance Program (LTAP) over the years, a program which is very valuable to UDOT and our partners in the local governments.

"Doug liked to do more than just come up with good ideas; he'd find somebody to make many of them happen. He was the master at getting something done by having someone else do it. That doesn't sound like it, but really was a good thing. It was more than just having too many ideas to deal with on his own, it was getting the right people involved so the ownership would be in the right place and the idea would get used." Says Gary Kuhl of Systems Planning and Programming and a long time friend and colleague to Doug.

While accomplishing these professional milestones, his personal life centered around his great family, outdoor activities, and TENNIS. He loves to travel and hike, with Mexico being one of his favorite destinations.

In 2002, he was awarded with the UTRAC Trailblazer Award, recognizing the long-term contribution he has made to transportation innovation in Utah. He has served on the Governor's Science Council, the AASHTO Research Advisory Council, and the UDOT Strategic Goals Task Force.

Those of us that have had the pleasure of working for him and with him through the years know that he is truly a fantastic person. We count him as friend. . . . ❑

We all wish Doug a great retirement and good luck in his future endeavors!

By Abdul Wakil
UDOT Research Division

You Know You Need To Contact Research When...

- You would like to learn more about how a new product performs on the road.
- You have a brilliant idea and/or product and would like a team of brilliant dedicated people to research it.
- You are introduced to a promising technology and do not have time and funding to test it.
- You require any technology transfer information or any experimental feature tested.
- You have a problem to be researched and solved.
- You require diligent inquiry about a subject matter and an analysis of scientific data.
- You have an article and would like the Research Division to publish it for you in its quarterly newsletter.
- You are in need of information through inter-library loan from other States.
- And more

Completed UDOT Research

Research publications are valuable resources, documenting the results of important research projects. For a list of recently completed Research Projects, please visit the Research & Development website at: www2.udot.utah.gov/index.php?m=c&tid=235. If you would like to obtain an electronic copy or a printed copy of our completed research, please contact awakil@utah.gov.

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Please send your comments and questions about this Newsletter to Abdul Wakil awakil@utah.gov or (801) 964-4455